A COMPUTATIONAL APPROACH FOR THREE-DIMENSIONAL SIMULATION OF DISCRETE CONCRETE CRACKING

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This work presents computational strategies used in an implementation of a probabilistic discrete cracking model for concrete suitable to parallel vector processor (PVP) environments. The computational strategies used for each realization, within the framework of Monte Carlo simulation, are the inexact Newton method to solve the highly non-linear problem and element-by-element (EBE) iterative strategies considering that nonlinear behavior is restricted to interface elements.

Fracturing is modeled by 3D interface elements that are generated in a previously defined region within the mesh. The interface elements are triangular base prisms connecting adjacent faces of neighboring tetrahedra. These elements simulate crack opening through relative displacements between the triangular faces.

The model is based on the assumption the some particularities of the cracking behavior of concrete, such as strain softening, cracking evolution, and size-effects are derived from the heterogeneous characteristics of the material. The stochastic process is introduced at the material local scale considering that cracks are created within the concrete with different energy dissipation depending on the spatial distribution of constituents and initial defects. The local material behavior in concrete is assumed to be a perfect elastic brittle behavior. This the random distribution of local cracking energies can be replaced by a random distribution of local strengths.

The code achieved a very good level for both parallel performance and vetorization. Extensive use of element-by-element techniques within the computational kernels comprised in the iterative solution drivers provided a natural way for achieving high Flop rates and good parallel speed-up's. Therefore, the computational strategies presented herein provide a natural way to deal with more complex scenarios, particularly those involving three-dimensional problems.

References

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